

Okumura et al. (the '115) discusses several embodiments (Figs. 1-10) of a plastic encapsulated lead-frame-type of semiconductor package that are substantially similar to one another except for certain structural details pertaining to the lead frame 9. In particular, all of the embodiments except one (the "sixth embodiment"), have a die pad (e.g., 11 in Figs. 1(a), 1(b)) connected at each of four corners to a frame (not illustrated) by "die pad support pins 10." The die pad support pins 10 are "upset," i.e., bent upward, "such that the die pad 11 is positioned higher in level than the leads 13" of the lead frame. (Figs. 1(a), 1(b); col. 6, line 3, *et seq.*) In other embodiments, the area of the die pad 18 is also made smaller than the area of the chip 19 (Fig. 2(b); col. 8, line 27, *et seq.*), and/or is provided with one or more variously shaped through-openings (see Figs. 3(b), 4(b), 5(b)). In the sixth embodiment, the die pad is omitted, and instead, the die 19 is mounted directly on the upper surface of the leads 23 in a "chip-on-lead" configuration. (Figs. 6(a), 6(b); col. 16, lines 12-17.)

The foregoing die pad arrangements purportedly permit 1) a thinner package (col. 7, line 5, *et seq.*), 2) a "direct" adhesion between the resin and the back surface of the die itself, and 3) a reduction in the amount of moisture-containing adhesive needed to attach the die to the lead frame, purportedly resulting in less cracking of packages. (See, e.g., col. 8, line 62, *et seq.*)

Also, in some of the embodiments described, the '115 discusses removing "the inner [and/or] outer bottom portions of each of the leads 13 ... to form a terminal portion constituted by a remaining projecting middle portion [16 having] its [bottom] surface exposed at the bottom face of the plastic while the other bottom portion thereof is buried in the sealing resin 15." (Fig. 7(b); col. 8, lines 3-10.) This configuration is achieved by a conventional "half-etching process" of the leads 13 that forms "stepped portions 22" on one or both sides of the "terminal portions 16" (col. 13, lines 11-15), which purportedly achieves an "anchoring effect" that "prevents the lead 13 from peeling off the sealing resin 15." (Col. 18, lines 10-12.)

However, and contrary to the Examiner's assertions above, there is no teaching or

... a recessed shoulder extending around the central portion of the die pad (the die pad), as distinctly claimed in claims 13, 22, and 26;

... means formed into a lower surface of the die pad for resisting penetration of moisture into the package along the die pad, as distinctly claimed in claim 32; and,

3) "the central portion of the lower surface of [a] die pad [being] exposed through a lower surface [of a plastic package body]." as distinctly claimed in claims 18 and 26.

Indeed, in view of the above teachings in the '115 of the desirability of having a thin layer of resin 15a *completely underlying the die pad and/or the die itself in all of the embodiments illustrated and described therein*, it is respectfully submitted that the '115 teaches *directly away* from a semiconductor package having an exposed die pad for enhanced thermal conductivity, much less any means for resisting penetration of moisture into the package along the periphery of the exposed portion of the die pad.

Moreover, while the '115 discloses undercutting the inner and outer ends of the leads 13 to create the "stepped portions 22," these structures are manifestly different from the "spatulate wire bonding pads" and "spatulate locking pads" respectively formed in the inner and outer end portions of the leads 16 of the present invention. This is because, while the former include the "stepped" feature of the latter pads, they lack the increased width, i.e., "spatulate," nature of the pads, relative to the leads, of the present invention, which are formed by a metal-*displacement* process, as opposed to a metal-*removal* process.

The spatulate pads of the present inventions provide not only a proportionally greater area for bonding with the plastic encapsulant than do the half-etched lead ends of the '115, but also a much larger area for bonding with conductive wires or the die, which in turn, permits the leads to be spaced much closer together than in the '115. These important distinctions between the '115 and the present invention are particularly pointed out in the instant specification at, *e.g.*, p. 8, lines 8-20, and p. 9, lines 1-15, and distinctly claimed in the recitation of "spatulate pads" in, *e.g.*, claims 13, 21, 23, 28, 31 hereof.

For the foregoing reasons, it is respectfully submitted that independent claims 13, 21, 23, and 28, as well as all of the claims respectively dependent from them, including claims 14-20, 22, 24-27, and 30-33, are patentably distinct over the '115. In light of this, the Examiner's rejection of claims 13-14, 17-18, and 20-33 under 35 U.S.C. 102(a) as being anticipated by Okumura et al. (the '115) is erroneous and should be withdrawn.

under 35 U.S.C. 102(a) as being unpatentable over Okumura et al. as applied to claim 1, above, and further in view of Yagi et al. (U.S. 6,025,640), stating, in pertinent part:

"The present invention provides a semiconductor device having a substrate with a plurality of leads extending from the substrate, and a plurality of pads extending from the substrate, the pads being spaced apart from the leads, and the pads being spaced apart from the leads, and the pads being spaced apart from the leads."

Yagi et al., however, teaches the lead frame 31 having an alloy of copper, or iron alloy containing nickel, see col. 10, lines 8-25.

Therefore, it would have obvious to one of ordinary skill in the art at the time of the invention was made to use such materials as shown above by Yagi et al. in Okumura et al. since these metals have higher conductivity.

In regards to claims 15-16, the width and the pitch of the leads and the pad as claimed are not patentable features since one of ordinary skill in the art would modify these measurements in the device to meet the design criteria." (Emphasis added.)

In view of the reasons given above regarding the patentability of claim 13 over Okumura et al. (the '115), and further in view of the Remarks that follow, this rejection is respectfully traversed.

Yagi et al. (the '640) discloses cylindrical "outer terminals 3B and 4B," but as tacitly conceded by the Examiner, does not supply any of the deficiencies in the teachings of the '115 *vis-à-vis* the exposed die pad, the recessed shoulder extending around a central portion thereof, or the spatulate bonding and locking pads of the present invention discussed above and distinctly claimed in claim 13, from which claims 15, 16 and 19 depend. Accordingly, even if the particular metal alloys taught in the '640 were combined with the teachings of the '115 as proposed by the Examiner, the invention claimed in claim 19 of the present invention would not result.

Further, as discussed above, the width and the pitch of the leads of the lead frame of the present invention as claimed in claims 15 and 16 are not simply matters of "design choice," or freely modifiable to meet other design criteria, as suggested by the Examiner. As particularly pointed out in the instant specification at, *e.g.*, page 10, line 9, *et seq.*, the novel spatulate wire bonding pads 42 of the present invention effectively enlarge the inner end portions of the leads 16 so that wire bonds can be made to them reliably. This, in turn, permits the leads 16 to be much narrower and more closely spaced than would otherwise be possible in conventional lead frame packages.

In light of the foregoing reasons, it is respectfully submitted that the Examiner's rejection of claims 15-16 and 19 under 35 U.S.C. 103(a) as being unpatentable over Okumura et al. (the '115) as applied to claim 13 above, and further in view of Yagi et al. (the '640) is un-

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WHEREFORE, each and every rejection raised by the Examiner in the Office Action of 04/25/01, having been fully addressed and overcome herein, it is respectfully submitted that

this Application, including pending apparatus claims 13-28 and 30-45, is now in a condition for allowance. An early notice thereof is therefore earnestly solicited by the Applicant.

If there are any questions regarding this Reply, the Examiner is invited to contact the undersigned at (949) 718-5200 to discuss.

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Respectfully submitted,



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ATTACHMENT A

This Reply amends claim 28 as follows, wherein additions are underlined, and deletions are [enclosed in brackets]:

28. A semiconductor package of a type that includes a ductile metal lead-frame having a plurality of elongate leads radiating out from a central die pad, a semi-conductor die mounted on the pad, a plurality of wire bonds connecting the die to the leads, and a protective plastic body molded over the leads, the pad, the die, and the wire bonds, the improvement in combination therewith comprising:

a spatulate locking pad formed into an outer portion of each lead and intersecting with a side wall of the plastic body.

[means formed into an outer portion of each lead and intersecting with a side wall of the plastic body for resisting penetration of moisture into the package along the lead.]